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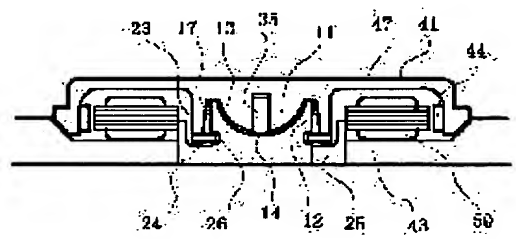
(54) MOTOR HAVING HEMISPHERICAL FLUID OR GAS DYNAMIC PRESSURE BEARING BALANCED WITH MAGNETIC ATTRACTIVE FORCE AT AXIAL END

(57)Abstract:
PROBLEM TO BE SOLVED: To achieve and provide a hemispherical fluid and gas dynamic pressure bearing motor that is suited for thinning and reduction in current, has a simple structure, and can reduce costs, by solving the problems of realization of stability in a rotary attitude, a structure that can be assembled easily, an the like that are the problems in the hemispherical fluid and gas dynamic pressure bearing motor.
SOLUTION: The motor comprises a shaft where at least one side is hemispherical, a sleeve having a recess that opposes the shaft, lubrication fluid in the gap between the shaft and the sleeve, and a magnetic means that has either a magnet or a magnetic body in the shaft or on the bottom surface of the sleeve and generates magnetic attraction force between a shaft end and a sleeve bottom surface. The motor has a dynamic pressure groove on the hemispherical bearing surface of the shaft or the sleeve, and balances the axial component force in load capacitance that the dynamic pressure groove generates in rotation and the magnetic attraction force for supporting the rotary section, inhibits NRRO for thinning, reduces current, and reduces costs.



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CLAIMS

[Claim(s)]
[Claim 1] The shaft which makes a side face hemispherical at least, and a sleeve with the crevice which counters a shaft, The magnetic means which it has [magnetic means] a magnet and the magnetic substance at either, respectively in the inside of a shaft, and the lubrication fluid of the gap between sleeves and a shaft, or the sleeve crowning, and generates the magnetic-attraction force between an axis end and a sleeve crowning, In the fluid hydrodynamic bearing motor which consists of annular obstructions which have the gap which is arranged at the axial periphery section, counters a sleeve peripheral wall, and serves as size gradually towards opening, and form the taper seal section The fluid hydrodynamic bearing motor characterized by having a dynamic pressure slot in the semi-sphere side of a shaft or a sleeve, equilibrating the shaft-orientations component of a force and said magnetic-attraction force of the load-carrying capacity which said dynamic pressure slot generates at the time of rotation, and supporting the rotation section [claim 2] In a fluid hydrodynamic bearing motor according to claim 1, constitute said magnetic means from a permanent magnet held movable in a shaft by adult holding power rather than said magnetic-attraction force, and the sleeve side magnetic substance, and it sets at said permanent magnet edge. It is the fluid hydrodynamic bearing motor [claim 3] characterized by size enabling justification and immobilization of said permanent magnet at the time of assembly so that it may not become from shaft-orientations surfacing distance [in / a sleeve is contacted at the time of quiescence, and it estranges at the time of rotation, and / in the clearance / the bearing surface of a shaft and a sleeve]. After constituting said magnetic means from a permanent magnet held movable in a shaft by adult holding power rather than said magnetic-attraction force, and the sleeve side magnetic substance in a fluid hydrodynamic bearing motor according to claim 1 and making a permanent magnet fully project from an axis end, between a shaft and a sleeve the force beyond said magnetic-attraction force In addition, so that the location of a permanent magnet may be decided in the condition that the flat spring arranged at the sleeve crowning or the sleeve crowning produces elastic deformation The crowning or flat spring, and permanent magnet edge of an assembly and a sleeve are a fluid hydrodynamic bearing motor [claim 4] characterized by constituting size so that it may not become from shaft-orientations surfacing distance [in / it contacts at the time of quiescence, it estranges at the time of rotation, and / in the clearance / the bearing surface of a shaft and a sleeve]. It is the fluid hydrodynamic bearing motor [claim 5] which has a dynamic pressure slot in a fluid hydrodynamic bearing motor according to claim 1 in the location which counters the shaft orientations of hemispherical bearing both sides of a shaft and a sleeve, and is characterized by hoop direction include-angle length differing, as for the dynamic pressure slot in each field. The fluid hydrodynamic bearing motor characterized by making the shaft-orientations movable distance of the rotation section restrict in a fluid hydrodynamic bearing motor according to claim 1 between the ring-like member fixed to said annular obstruction edge, and the annular crevice established in the sleeve peripheral wall corresponding to the ring-like member [claim 6] It is the fluid hydrodynamic bearing motor [claim 7] which presupposes that said ring-like member is fixed to said annular obstruction edge with means, such as HAME ****, adhesion, or welding, in a fluid hydrodynamic bearing motor according to claim 5, and is characterized by having an access hole required for immobilization in the fixed part side which counters said annular obstruction edge, or rotation section flank material. Have a means to insert in an annular obstruction edge and each other's ring-like member, and to fix in a fluid hydrodynamic bearing motor according to claim 6, and an access hole is minded. The fluid hydrodynamic bearing motor characterized by dashing against the end face of said annular crevice where push elastic deformation of the inner circumference part of a ring-like member is carried out, inserting each other's ring-like member in an annular obstruction edge, fixing, and carrying out an adjustment setup of the shaft-orientations movement magnitude of moving part as said elastic deformation of a ring-like member [claim 8] The fluid hydrodynamic bearing motor characterized by making cellular exclusion in a lubrication fluid easy in a fluid hydrodynamic bearing motor given in claim 1 term, using magnetic fluid oil as a lubrication fluid [claim 9] The fluid hydrodynamic bearing motor characterized by mixing conductive magnetic-

substance fines into a lubrication fluid, making a bridge construct between an axis end and a sleeve crowning in a fluid hydrodynamic bearing motor according to claim 1, and making it flow electrically [claim 10] The shaft which makes a side face hemispherical at least, and a sleeve with the crevice which counters a shaft, In the gas hydrodynamic bearing motor which consists of magnetic means which it has [magnetic means] a magnet and the magnetic substance in the inside of a shaft, or the sleeve crowning at either, respectively, and generate the magnetic-attraction force between an axis end and a sleeve crowning The gas hydrodynamic bearing motor characterized by having a dynamic pressure slot in the semi-sphere side of a shaft or a sleeve, equilibrating the shaft-orientations component of a force and said magnetic-attraction force of the load-carrying capacity which said dynamic pressure slot generates at the time of rotation, and supporting the rotation section [claim 11] In a gas hydrodynamic bearing motor according to claim 10, constitute said magnetic means from a permanent magnet held movable in a shaft by adult holding power rather than said magnetic-attraction force, and the sleeve side magnetic substance, and it sets at said permanent magnet edge. It is the gas hydrodynamic bearing motor [claim 12] characterized by size enabling justification and immobilization of said permanent magnet at the time of assembly so that it may not become from shaft-orientations surfacing distance [in / a sleeve is contacted at the time of quiescence, and it estranges at the time of rotation, and / in the clearance / the bearing surface of a shaft and a sleeve]. After constituting said magnetic means from a permanent magnet held movable in a shaft by adult holding power rather than said magnetic-attraction force, and the sleeve side magnetic substance in a gas hydrodynamic bearing motor according to claim 10 and making a permanent magnet fully project from an axis end, between a shaft and a sleeve the force beyond said magnetic-attraction force In addition, so that the location of a permanent magnet may be decided in the condition that the flat spring arranged at the sleeve crowning or the sleeve crowning produces elastic deformation The crowning or flat spring, and permanent magnet edge of an assembly and a sleeve are a gas hydrodynamic bearing motor [claim 13] characterized by constituting size so that it may not become from shaft-orientations surfacing distance [in / it contacts at the time of quiescence, it estranges at the time of rotation, and / in the clearance / the bearing surface of a shaft and a sleeve]. It is the gas hydrodynamic bearing motor [claim 14] which has a dynamic pressure slot in a gas hydrodynamic bearing motor according to claim 10 in the location which counters the shaft orientations of bearing both sides of a shaft and a sleeve, and is characterized by hoop direction include-angle length differing, as for the dynamic pressure slot in each field. A gas hydrodynamic bearing motor according to claim 10 The gas hydrodynamic bearing motor characterized by it having been alike, having set and making the shaft-orientations movable distance of the rotation section restrict between the ring-like member fixed to an end of the sleeve, and the annular crevice established in the fixed side corresponding to the ring-like member [claim 15] It is the gas hydrodynamic bearing motor [claim 16] which presupposes that said ring-like member is fixed to said sleeve edge with means, such as HAME ****, adhesion, or welding, in a gas hydrodynamic bearing motor according to claim 14, and is characterized by having an access hole required for immobilization in the fixed part flank material which counters said sleeve edge. It is the gas hydrodynamic-bearing motor characterized by to dash against the end face of said annular crevice where push elastic deformation of free one end of a ring-like member is carried out through an access hole, to insert each other's ring-like member in a sleeve edge, to fix [to have a means to insert in a sleeve edge and each other's ring-like member, and to fix in a gas hydrodynamic bearing motor according to claim 15,], and to carry out an adjustment setup of the shaft-orientations movement magnitude of moving part as said elastic deformation of a ring-like member.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] Especially this invention relates to the fluid and gas hydrodynamic bearing motor which have bearing of a semi-sphere configuration and enable thin-shape-izing and low cost-ization with respect to a fluid and a gas hydrodynamic bearing motor.
[0002]
[Description of the Prior Art] In the storage of a rotation mold, the fan for cooling, etc., it is in the adoption direction of a fluid hydrodynamic bearing motor from the request of NRRO (asynchronous shaft deflection) control of silence or body of revolution etc. Coincidence is called on for thin-shape-izing of these devices, low current-ization, etc. with progress of a portable way. However, a fluid hydrodynamic bearing has a limitation in thin shape-ization that it is hard to make small the span between the bearing sections which support a shaft from a viewpoint which oppresses NRRO, and needs the process tolerance below submicron one for bearing gap maintenance, and a difficult situation has low cost-ization.
[0003] Even if it eases the process tolerance of a member for low cost-ization further, it is realizing **, such as structure it being freed from the bearing supported by two points of shaft orientations to enable thin shape-ization in a fluid hydrodynamic bearing, structure which can decrease a bearing sliding aspect product for low current-ization, and structure a bearing gap's being maintainable in a required precision.
[0004] The fluid hydrodynamic bearing of the semi-sphere configuration which serves as this candidate could support the load of a radial and the thrust direction, and has attracted attention since before. However, although the single semi-sphere configuration bearing suitable for thin shape-ization also has the example of a gas bearing shown in USP05854524, it has not spread. Since one of the reason of the has acquired the magnetic-attraction force equilibrated with a hemispherical hydrodynamic bearing from between the rotor magnet and the stator core, it is it being the structure which spoils posture stability, having the wear problem with the structure the bearing surface's sliding further at the time of deactivation, etc.
[0005]
[Problem(s) to be Solved by the Invention] The technical problems in the fluid and gas hydrodynamic bearing motor of a semi-sphere configuration are the stability of a rotation posture, and implementation of structure with little sliding wear, and, in the case of a fluid hydrodynamic bearing, it is implementation of the structure where a lubrication fluid cannot leak further easily. The purpose of this invention is solving said technical problem, and it being suitable for thin-shape-izing and low current-ization, and making implementation offer of the fluid and gas hydrodynamic bearing motor of the semi-sphere configuration in which low-cost-izing is possible with simple structure.
[0006]
[Means for Solving the Problem] The fluid hydrodynamic-bearing motor by this invention consists of annular obstructions which have the gap which is arranged at an abbreviation semi-sphere-like shaft, a sleeve with the crevice which counters a hemispherical shaft, a shaft and the lubrication fluid of the gap between sleeves, the magnetic means that generates the magnetic-attraction force between an axis end and a sleeve crowning, and the axial periphery section, and counters a sleeve peripheral wall, and serves as size gradually towards opening, and constitute the taper seal section. In this fluid hydrodynamic bearing motor, it is characterized by having a dynamic pressure slot in the hemispherical bearing surface of a shaft or a sleeve, equilibrating the shaft-orientations component of a force and said magnetic-attraction force of the load-carrying capacity which said dynamic pressure slot generates at the time of rotation, and supporting the rotation section. Seal structure of a stable lubrication fluid is realized as structure which arranges the interface of a lubrication fluid on a sleeve periphery also at the time of high-speed rotation.
[0007] A ring-like member is fixed to the annular obstruction edge of arrangement in the axial periphery section, the inner circumference section of the ring-like member is arranged so that it may become in the

annular crevice of a sleeve peripheral wall, and the shaft-orientations movement magnitude of the rotation section is regulated. The rotation section at the time of being added escapes from an excessive impact, and it is stop structure.
[0008] Moreover, making conductive magnetic-substance fines mix into a lubrication fluid, making it restrain in the field between an axis end and a sleeve crowning, and constituting the electric earthing means of the rotation section has also proposed.
[0009] The gas hydrodynamic-bearing motor by the second this invention is characterized by to constitute from an abbreviation semi-sphere-like shaft, a sleeve with the crevice which counters a hemispherical shaft, a magnetic means that generates the magnetic-attraction force between an axis end and a sleeve crowning, to have a dynamic-pressure slot in the hemispherical bearing surface of a shaft or a sleeve, to equilibrate the shaft-orientations component of a force and said magnetic-attraction force of the load-carrying capacity which said dynamic pressure slot generates at the time of rotation, and to support the rotation section.
[0010] A ring-like member is fixed to a sleeve end face, the free edge side of the ring-like member is arranged so that it may become in the annular crevice by the side of a fixed part, and the shaft-orientations movement magnitude of the rotation section is regulated. The rotation section at the time of being added escapes from an excessive impact, and it is stop structure.
[0011] In the above-mentioned fluid and a gas hydrodynamic bearing, the magnetic means which generates the magnetic-attraction force consists of the permanent magnets and the magnetic substance which have been arranged in the inside of a shaft, or the sleeve crowning which counters, respectively. The magnetic-attraction force of an axis end is combined with the load-carrying capacity which a dynamic pressure slot generates, forms posture stability, and can improve posture stability.
[0012] In a shaft, the permanent magnet held movable by adult holding power from the magnetic-attraction force It has. The location of a permanent magnet is made to decide in the condition that the flat spring which applied the force beyond the magnetic-attraction force between the shaft and the sleeve, and has been arranged at the sleeve crowning or the sleeve crowning after making a permanent magnet fully project from an axis end at the time of assembly produces elastic deformation. shaft-orientations surfacing distance [in / a sleeve crowning or a flat spring, and a permanent magnet edge contact at the time of quiescence, are estranged at the time of rotation, and / in the clearance / the bearing surface of a shaft and a sleeve] -- smallness -- or it constitutes so that it may become equal. Thereby, at the time of deactivation, sliding in the bearing surface of a shaft and a sleeve is decreased, and dependability can be improved.
[0013] The structure of distributing the amount of delay until it allots the dynamic pressure slot where hoop direction include-angle length differs, respectively in the almost same shaft-orientations location of the shaft which furthermore counters, and sleeve bearing both sides and becomes a maximum pressure power point from the least interval point of a hoop direction, and avoiding unstable phenomena, such as half HOWARU, is proposed.
[Function] If it depends on the fluid and gas hydrodynamic bearing motor by this invention, the load-carrying capacity generated by rotation will be perpendicular to the hemispherical bearing surface, and a shaft and a sleeve will be rotated by non-contact in the location where the shaft-orientations component of a force and magnetic-attraction force balance. The direction component of a force of a path of load-carrying capacity balances on each point of a hoop direction, respectively, and contributes to alignment of the rotation section.
[0014] The technical problem in the conventional single spherical bearing was sliding wear of posture stability and the bearing surface. In this invention, the magnetic-attraction force in an axis end makes the load-carrying capacity and the posture resisting moment force which a dynamic pressure slot generates form, and the dynamic pressure slot where the hoop direction include-angle length in bearing both sides differs further can expect effectiveness, such as reducing half HOWARU, and can improve posture stability. Moreover, sliding of the bearing surface which tends to happen at the time of deactivation is reduced by the lobe of an axis end, and can improve the life of bearing.
[0015]
[Embodiment of the Invention] It explains below, referring to a drawing for the example, a principle operation, etc. about the fluid and gas hydrodynamic bearing motor by this invention.
[0016] Drawing 1 shows the cross-section structure of the fluid hydrodynamic bearing motor which is the first example of this invention. A shaft 11 makes a side face a semi-sphere configuration, and the sleeve 12 which counters a shaft 11 and is arranged makes a side face a hemispherical concave surface. The gap between a shaft 11 and a sleeve 12 is filled up with the magnetic fluid oil which is a lubrication fluid, and the gap of the annular obstruction 23 formed in the periphery section of a shaft 11 and the peripheral wall of a sleeve 12 forms the taper seal section in shaft orientations as a size gradually, and has the interface 17 of a lubrication fluid. A shaft 11 has a permanent magnet 35 in it, and generates the magnetic-attraction force between sleeve

12 crownings which consisted of the magnetic substance. Consisting of the rotation section from a shaft 11, an annular obstruction 23, a hub 41, and rotor magnet 44 grade, a fixed part consists of a sleeve 12, the base 43, a stator core 47, and coil 50 grade.

[0017] The dynamic pressure slot of a herringbone configuration explained later is ******(ed) in which the hemispherical bearing surface 13 of a shaft 11 and a sleeve 12, and the bearing section is formed in it. The dynamic pressure slot of this lot carries out the pumping of the lubrication fluid toward that core, and heightens the pressure of a lubrication fluid. Since the load-carrying capacity produced as a result is in inverse proportion to a shaft and the gap between sleeves, said gap is determined that the shaft-orientations component of a force and said magnetic-attraction force of load-carrying capacity will balance, and alignment of a shaft 11 is performed by the direction component of a force of a path of load-carrying capacity. Therefore, since the magnitude of load-carrying capacity is decided by the magnetic-attraction force, it supposes that the magnetic-attraction force is set up so that sufficient load-carrying capacity to support the rotation section at the time of rotation can be generated, and a gap serves as a value of several micron meter about.

[0018] A stator core 47 and a coil 50 collaborate with the rotor magnet 44, and rotate the rotation section. In addition to this, a magnetic disk or an optical disk is carried in the rotation section as a load, and the force in which it is added between a shaft 11 and a sleeve 12 according to the installation gestalt of stores, such as erection or a handstand, differs. That is, by erection, in addition to the magnetic-attraction force, moving-part weight is added, and by handstand, moving-part weight is conversely deducted from the magnetic-attraction force, and it is added. If they are taken into consideration, as magnetic-attraction force, 3 or more times of moving-part weight will be a standard, and, also experientially, the stability of an appropriate posture will be acquired. Although a precession can be compressed further and posture stability can be increased if the magnetic-attraction force is made into size and bigger load-carrying capacity is made to balance, on the other hand, it has also become clear that the sliding friction at the time of deactivation is made into size, and an operation life is reduced. Although it changes with required rotation precision, in the case of a small magnetic disk drive, it sets up as a near standard so that the about 5 times [of moving-part weight] magnetic-attraction force in which load weight was applied to the rotation section weight of a fluid hydrodynamic bearing motor may be generated.

[0019] Drawing 2 shows the cross section of a shaft 11, a permanent magnet 35, and sleeve 12 grade, and the path of magnetic flux. A shaft 11 is made into a non-magnetic material, and arranges the powerful permanent magnet 35 of rare earth in a shaft. The path of a permanent magnet 35 can assign about 1 - 2 millimeters on a design under the condition that the path of bearing is about 5 millimeters. Since the distance of the tip of a shaft 11 and a sleeve 12 is set as an about [20-30 micron m] minute gap, the magnetic-attraction force does not depend on the gap fluctuation, but becomes almost fixed, and processing assembly tolerance is made as for it to size. A number 55 shows the magnetization direction of a permanent magnet 35, permanent magnet 35 tip centralizes magnetic flux as the spherical surface, and the magnetic flux 56 which flowed into sleeve 12 crowning returns from the hemispherical bearing surface of a sleeve 12 to the other end of a permanent magnet 35 through the inside of a sleeve 12 so that it may be shown as a number 57 (number 58). Since the distance of area from the hemispherical bearing surface to permanent magnet 35 edge is moreover large in size, magnetic flux 58 of flux density is dispersedly small, and is small. [of the magnetic-attraction force of the hemispherical bearing surface of a sleeve 12 and a permanent magnet 35]

[0020] Since magnetic fluid oil was used as a lubrication fluid, the centripetal force to magnetic fluid oil works near [where flux density is high] the crowning, and the cellular exclusion from a crowning and bearing can be promoted. Trouble does not have usual oil in functional implementation of bearing, either.

[0021] Making the generating means of the magnetic-attraction force deflect the rotor magnet 44 and a stator 47 to shaft orientations otherwise, or arranging the piece of the magnetic substance under the rotor magnet 44 etc. exists. The former induces vibration and the latter has the demerit which makes the consumed electric current size by the eddy current produced in the piece of the magnetic substance. With the magnetic-attraction force generating means shown in the example of this invention, the fault of the above-mentioned means is solvable.

[0022] Drawing 3 shows the detail structure of the bearing part in the first example, drawing 3 (a) shows a shaft 11 and the cross-section structure of a sleeve 12, and drawing 3 (b) shows the top view of a sleeve 12, respectively. The dynamic pressure slots 20 and 21 of the front face of a shaft 11 were repeatedly shown with it being easy to understand the location of the shaft orientations of a dynamic pressure slot in the sectional view, and the dynamic pressure slots 27 and 28 of the bearing surface 13 of a sleeve 12 were shown on the top view. The dynamic pressure slots 20, 21, 27, and 28 are the depressions about several micron meter, at the time of rotation, they bring a lubrication fluid together in pars intermedia from an inner circumference and periphery side, heighten the pressure of a lubrication fluid, and surface and support a shaft 11 to a sleeve 12.

The pumping capacity from a periphery side to an inner circumference side is set up so that the pumping force by the side of inner circumference may remain as a size a little from it from an inner circumference side to a periphery side, the pressure of the lubrication fluid by the side of inner circumference is promptly made into size at the time of rotation starting, and the sliding friction of a shaft 11 and a sleeve 12 is made to mitigate in this example. Although the slot length by the side of the inner circumference section (20 27) is expressed with the dynamic pressure slot shown in drawing to size, since pumping capacity is decided by contraction extent of the hoop direction die length of a slot, the direction die length of a path of a slot, etc., it is not contradictory to the above-mentioned explanation.

[0023] Since the taper seal section of a lubrication fluid has been arranged on the periphery of a sleeve 12, effectiveness is in thin shape-ization of the whole motor, and since the tooth space of the shaft orientations of the taper seal section can fully be taken, the seal structure of a lubrication fluid firm as a small include angle of 10 or less degrees is [a taper angle] realizable. Moreover, since the interface 17 of a lubrication fluid has been arranged between sleeve 12 peripheral walls and the annular obstructions 23 near almost perpendicularly, there is little concern from which a lubrication fluid leaks with a centrifugal force also in high-speed rotation.

[0024] The dynamic pressure slots 20 and 21 of shaft 11 front face and the dynamic pressure slots 27 and 28 of sleeve 12 front face are characterized by hoop direction include-angle length differing. In this example, the hoop direction include-angle length of the dynamic pressure slots 27 and 28 of sleeve 12 front face is set up the more than twice of the dynamic pressure slots 20 and 21 of shaft 11 front face. The arrow head of a number 30 shows the hand of cut of a shaft 11.

[0025] The capacity which a dynamic pressure slot carries out the pumping of the lubrication fluid at the time of rotation, heightens a pressure, and heightens a pressure generates posture stability almost in inverse proportion to a bearing gap. Since it is distributed over a hoop direction, even if it carries out eccentricity and a bearing gap serves as smallness locally, by the time the effect is reflected as a pressure-distribution difference in a hoop direction, delay will produce a dynamic pressure slot, and the amount of delay is proportional to the include-angle length of the hoop direction of a dynamic pressure slot. As for the control system with delay, causing resonance phenomena of a certain kind is known by control from change of a controlled variable-ed, and, in the case of a fluid hydrodynamic bearing, the unstable phenomenon of a precession, an oil-whip, etc. is caused.

[0026] Therefore, it is making it distribute the above-mentioned amount of delay suitably to make this kind of unstable phenomenon mitigate, for example, the die length of the hoop direction of the dynamic pressure slot 21 is distributed, and it constitutes. However, if the include-angle length of the dynamic pressure slot which has only some to per round is distributed, the demerit of unequal and others of posture stability will also be actualized. In this invention, coexistence of the dynamic pressure slot of hoop direction include-angle length which forms in shaft 11 front face and sleeve 12 front face the dynamic pressure slot where hoop direction include-angle length differs, respectively, and is different from the homogeneity to the hoop direction of the posture stability by the heightened pressure was realized and solved. Generally processing of a dynamic pressure slot is not easy, and constituting to both sides of bearing causes a cost rise. In this example, since die forming is all possible for the hemispherical shaft 11 and the hemispherical sleeve 12, the fluid hydrodynamic bearing motor by which it does not become a cost rise factor and a precession cannot happen easily is realizable.

[0027] The gap of the annular obstruction 23 and the peripheral wall of a sleeve 12 forms the taper seal section which carries out the seal of the lubrication fluid to shaft orientations with surface tension as a size gradually. The ring-like member 24 is fixed to the edge of the annular obstruction 23, and the inner circumference section of the ring-like member 24 is in the annular crevice 26 established in the sleeve 12 periphery wall surface, and restricts migration to the shaft orientations of the rotation section. The ring-like member 24 uses elasticity, or puts some rings on the annular crevice 26 free [rotation] beforehand at the time of notching and assembly, and fixes the ring-like member 24 to annular obstruction 23 edge by spot welding, adhesion, etc. through the access hole 25 prepared in the member which counters with the annular obstruction 23 after an assembly. The access hole 25 fixes [at a hoop direction] those with three piece, and the ring-like member 24 to homogeneity by three points in a hoop direction.

[0028] Drawing 4 explains that the load-carrying capacity which appears between a shaft 11 and a sleeve 12 as a result of the pressure distribution in the lubrication fluid generated at the time of rotation and pressure distribution is shown, and the stability of a rotation posture is acquired. The pressure distribution at the time of the rotation in the above-mentioned dynamic pressure slot structure etc. are shown in drawing 4 (a). A number 73 shows the coordinate of shaft orientations, a number 74 shows a pressure value, respectively, and numbers 75, 76, 77, 78, and 79 show the average pressure of a hoop direction in each shaft-orientations location. since atmospheric pressure is deducted, zero are shown, a pressure 76 increases by the dynamic pressure slot 21,

and the pressure value 75 in the periphery section serves as about 1 law in the center section, as a number 77 shows. In the part equivalent to the location of the dynamic pressure slot 20, a pressure decreases, as shown in a number 78, and in the crowning 14, as shown in a number 79, it becomes an adult value from atmospheric pressure a little.

[0029] Although a rotation section posture is fundamentally held with the high pressure 77 in this center section, drawing 4 (b) explains to a detail further. The pressure distributions 75, 76, 77, 78, and 79 shown in drawing 4 (a) are the average values of a hoop direction, and when a shaft 11 and a sleeve 12 carry out eccentricity or it inclines, the pressure distributions of a hoop direction also differ locally. Drawing 4 (b) shows the situation which the sleeve 12 to rotate inclines to the left and is rotating. If the load-carrying capacity which grooves 20 and 21 generate is uniform to a hoop direction, it is lost, and if it is made to represent with load-carrying capacity 68 and left-hand side as 67 and thinks on the right-hand side, 67 of a side with a small bearing gap will become size. These load-carrying capacity 67 and 68 works at right angles to the bearing surface, and generates the magnetic-attraction force 83 of an axis end, and the moment force of posture restoration. Although only the moment force on either side was taken up in this explanation since it was easy, the moment force in each point of a circumferencial direction and shaft orientations will balance in fact.

[0030] In the viscosity of the oil used as a lubrication fluid, generally at an elevated temperature, load-carrying capacity decreases by smallness. Although it sets up in the conventional design so that load-carrying capacity can be secured with allowances in the upper limit of operating temperature limits, it is afflicted by superfluous load-carrying capacity and the excessive current at low temperature as the result. If it depends on this invention, since the gap between a shaft 11 and a sleeve 12 becomes settled in the location where the shaft-orientations component of a force and the magnetic-attraction force of load-carrying capacity 67 and 68 balance, load-carrying capacity will be kept almost constant irrespective of temperature. That is, temperature compensation is made automatically, the load-carrying capacity set point in a design is crossed to the total-temperature range, is made with a fixed value, can avoid the superfluous load-carrying capacity in low temperature, an excessive current, etc., and the low current-ized design of it is attained.

[0031] Furthermore, since **** in a fluid hydrodynamic bearing originates in the frictional force of the lubrication fluid in the interval spare time part which mainly has a dynamic pressure slot, and the field of a shaft 11 and sleeve 12 grade, if it has a dynamic pressure slot by minimum configuration called a lot like this invention, **** is small also from this point and low current-ization can be attained.

[0032] Drawing 5 explains that the magnetic-attraction force of an axis end is still more effective in restoration of a rotation posture. The example to which drawing 5 (a) has the magnetic-attraction force in an axis end, and drawing 5 (b) show the example which makes a rotor magnet a magnetic-attraction force generating means. Since the upper part of a shaft 11 shows the example leaning to the left, as drawing 4 (b) explained, two points of right and left of the load-carrying capacity by dynamic pressure generating are represented with these drawings, and they show as numbers 67 and 68. As drawing 4 (a) explained in size from load-carrying capacity 68, the resisting moment force of a rotation posture generates the load-carrying capacity 67 used as the smallness of the gap between bearing. In drawing 5 (a), it turns out easily that the magnetic-attraction force 83 of an axis end generates the resisting moment force of load-carrying capacity 67 and 68 and a rotation posture further. the magnetic-attraction force 84 it was weak to the smallness of a gap since the magnetic-attraction force 84 and 85 between the rotor magnet 44 and the piece 53 of the magnetic substance was in inverse proportion to the gap although the magnetic-attraction force 84 and 85 on either side balanced mostly in the example of drawing 5 (b) which makes one rotor magnet 44 a magnetic-attraction force generating means -- the magnetic-attraction force 85 -- size -- becoming -- rather -- the inhibition factor of rotation posture restoration -- it becomes. Thus, the structure of having the magnetic-attraction force in an axis end contributes to stabilization of a rotation posture further.

[0033] Drawing 6 and drawing 7 show the detail structure of the drawing 1 example where it was made for a shaft and a sleeve not to touch completely in the bearing surface at the time of quiescence. In drawing 6 , in a shaft 11, it has the movable permanent magnet 35 which contacts sleeve 12 crowning at the time of quiescence, and has a flat spring 33 in the crowning of a sleeve 12. Although shaft 11a shown by the dotted line shows the location at the time of quiescence and the shaft 11 of a continuous line shows the location at the time of rotation, respectively, f determines that it is always more nearly equal than d, or the amount of protrusions of a permanent magnet 35 becomes size, using the shaft-orientations flying height in the bearing surface between d, a sleeve 12, and a shaft 11 as f for the gap of the permanent magnet 35 edge and flat spring 33 at the time of rotation. As the standard, the flying height f of a sleeve 12 will set it as about 5 micron m, if (f-d) has the flying height f in the range which is 10 -20-micron meter since it changes with temperature. Thus, at the time of rotation, permanent magnet 35 edge is carried out about 5 micron m, the bearing surface at least carries out 10 - 20-micron meter surfacing at shaft orientations, and a rotation posture is not affected.

[0034] Although possibility of sliding and wearing bearing out at the time of deactivation, and spoiling a life or dependability is generally high in a fluid hydrodynamic bearing, since it is only that permanent magnet 35 edge and a flat spring 33 slide, if measures against wear, such as ceramic material pasting and plating processing, are taken against permanent magnet 35 point and the flat spring 33 which counters, the engine performance can be stabilized over a long period of time by this example.
[0035] Drawing 7 is drawing for explaining justification of the permanent magnet 35 in drawing 6 . In the cylinder 32 within a shaft 11, a permanent magnet 35 is held movable by adult holding power rather than the magnetic-attraction force by eye a running fit. A permanent magnet 35 is made to fully project beforehand on a shaft 11 at the time of assembly, a sleeve 12 is combined, and apply an adult push pressure between a sleeve 12 and a shaft 11 from the magnetic-attraction force, and the crowning of a sleeve 12 is made to contact, and a push pressure is removed where elastic deformation of the flat spring 33 arranged in the sleeve 12 crowning is carried out. After removing a push pressure, a flat spring 33 returns to the original configuration, and the shaft 11 which dotted-line 11b shows the shaft in the condition of having applied the push pressure, and is shown as a continuous line shows the condition that the gap was established in the bearing surface of a shaft 11 and a sleeve 12. The same effectiveness can be acquired even if it uses the elastic deformation of the crowning of a sleeve 12 instead of using the elastic deformation of a flat spring 33.
[0036] After justifying, a permanent magnet 35 can also oppose excessive impulse force, if it fixes by adhesion or welding. After a cylinder's 32 holding a permanent magnet by clearance BAME or the **** stop as a through tube, making it fully project at the time of assembly and making it contact the crowning 14 of a sleeve 12, it can make a considerable amount (f-d) able to project through a through tube, and can also perform justification and immobilization. Although a shaft 11 can also be set as the permanent magnet 35 shown in the example of drawing 6 to immobilization from the beginning, the path dimension of the amount of protrusions of a permanent magnet 35, a shaft 11, and a sleeve 12 must be managed in that case. Although a dimensional control is also easy when the engine-performance demand of NRRO as a fluid hydrodynamic bearing motor etc. is comparatively loose, when an engine-performance demand is severe, it is difficult, and the structure which justifies a permanent magnet like this example is low as total cost.
[0037] Drawing 8 shows the example which can adjust the shaft-orientations location of a ring-like member, and drawing 8 (a) expands the sectional view of a bearing part, drawing 8 (b) expands the cross-section section 89 of the ring-like member circumference, and it is shown. In this example, the edge of the annular obstruction 23 shall have the through tube which joints a projected part 86 with the ring-like member 24. The ring-like member 24 is beforehand inserted in the annular crevice 26 of the sleeve 12 periphery section, is combined with a shaft 11, it dashes the inner circumference section of the ring-like member 24 against the edge 87 of said annular crevice 26 with a jig 88 while it makes the through tube of said projected part 86 and the ring-like member 24 joint through the access hole 25, is mutually inserted in said projected part 86, and is made to fix it, after the ring-like member 24 has carried out elastic deformation.
[0038] The shaft-orientations elastic deformation of the ring-like member 24 considers as about 20 micron m in said assembly process, and even when the reinforcement of the ring-like member 24 and said projected part 86 which suiting inserts in is fully applied to size, then an impact, the shaft-orientations movement magnitude of moving part including a hub 12 can be restricted to an about [20 micron m] slight amount. Although the demand given to wanting to restrict the shaft-orientations movement magnitude of a magnetic disk to a slight amount is strong, a demand can be filled with examples, such as HDD, by using the elastic deformation of the ring-like member 24 like this example, without setting up each part material tolerance severely. The ring-like member 24 and said projected part 86 can be assembled, can raise bonding strength with means, such as adhesion and welding, further behind, and can also raise shock resistance.
[0039] In the first example of this invention, it considered as the structure which eliminates the joint between members at the part which a lubrication fluid contacts. Although the seal of the member joint was carried out by caulking, adhesion, or laser ** arrival in the conventional structure, at the time of mass production, junction was often poor, the leakage of a lubrication fluid was produced and the fatal failure was caused. The fluid hydrodynamic bearing by this invention can eliminate the joint which touches a lubrication fluid, as shown in an example, and it can realize a fluid hydrodynamic bearing motor without oil leakage concern.
[0040] Moreover, if conductive magnetic-substance fines are made to mix into a lubrication fluid, the bridge formation flow of between the axis end which a field concentrates, and a sleeve can be carried out, and the flow between the rotation section and a fixed part can be realized easily.
[0041] Drawing 9 shows the cross-section structure of the gas hydrodynamic bearing motor which is the second example of this invention. A shaft 11 is made into a semi-sphere configuration, and makes the sleeve 12 which counters a shaft 11 and is arranged a hemispherical concave surface. A shaft 11 has a permanent

magnet 35 in it, and generates the magnetic-attraction force between sleeve 12 crownings which consisted of the magnetic substance. It has a dynamic pressure slot in which the hemispherical bearing surface 13 of a shaft 11 and a sleeve 12, and the bearing section is formed in it. This dynamic pressure slot carries out the pumping of the air toward that core, and heightens the pressure of air. Since the load-carrying capacity produced as a result is in inverse proportion to a shaft and the gap between sleeves, said gap is determined that the shaft-orientations component of a force and said magnetic-attraction force of load-carrying capacity will balance, and alignment of a shaft 11 is performed by the direction component of a force of a path of load-carrying capacity. Therefore, since the magnitude of load-carrying capacity is decided by the magnetic-attraction force, it sets up the magnetic-attraction force so that sufficient load-carrying capacity to support the rotation section at the time of rotation can be generated.

[0042] A number 34 shows an air hole and makes the air pressurized by the crowning 14 through the gap of permanent magnet 35 side face reveal to the bearing periphery section. The path of an air hole 34 is made into smallness, or it is filled up with the fibrous quality-of-the-material and porosity quality of the material etc., and passage resistance is adjusted, while making surfacing at the time of starting prompt by making the pressure of a crowning 14 leave moderately, when impulsive vibration source is added, pressurization air is missed and extent of damping is controlled.

[0043] Consisting of the rotation section from a sleeve 12, a rotor magnet 46, and magnetic-disk 91 grade, a fixed part consists of a shaft 11, the base 43, a stator core 49, and coil 52 grade. A number 90 constitutes magnetic shielding from the magnetic substance.

[0044] Drawing 10 shows the detail structure of the bearing part in the second example shown in drawing 9 , drawing 10 (a) shows the top view of a sleeve 12, and drawing 10 (b) shows a shaft 11 and the cross-section structure of a sleeve 12, respectively. As shown in drawing 10 (a), a lot and shaft 11 front face are countered in the dynamic pressure slot 18 of a herringbone configuration in the bearing surface of a sleeve 12, and the dynamic pressure slot 19 is formed 1 set. The dynamic pressure slots 18 and 19 are the depressions about several micron meter, at the time of rotation, they bring air together in the core of the dynamic pressure slots 18 and 19, i.e., the crookedness part of the dynamic pressure slots 18 and 19, from an inner circumference and periphery side, heighten the pressure of air, and surface and support a sleeve 12 to a shaft 11. The pumping capacity from a periphery side to an inner circumference side is set up so that the pumping force by the side of inner circumference may remain as a size a little from it from an inner circumference side to a periphery side, the pressure of the air by the side of inner circumference is promptly made into size at the time of rotation starting, and the sliding friction of a shaft 11 and a sleeve 12 is made to mitigate in this example. Moreover, the hoop direction include-angle length of the dynamic pressure slot 19 is taken as the abbreviation half of the dynamic pressure slot 18. The ring-like member 24 which regulates the shaft-orientations movement magnitude of the rotation section is formed in the sleeve 12 periphery edge. Since other structures, a function, etc. are the same, the same number as the first example is given to the same member, and explanation is omitted.

[0045] Drawing 11 and drawing 12 show the detail structure of the second example where it was made for a shaft and a sleeve not to touch completely in the bearing surface at the time of quiescence. In drawing 11 , it has the movable permanent magnet 35 which contacts sleeve 12 crowning at the time of quiescence in a shaft 11. Although the sleeve 12 sleeve 12a shown by the dotted line indicated the location at the time of quiescence to be as the continuous line shows the location at the time of rotation, respectively, it is determined that f is always more nearly equal than d, or the amount of protrusions of a permanent magnet 35 becomes size, using the shaft-orientations flying height in the bearing surface between d, a sleeve 12, and a shaft 11 as f for the gap of permanent magnet 35 edge at the time of rotation, and the crowning of a sleeve 12. As the standard, the flying height f of a sleeve 12 will set it as about 5 micron m, if (f-d) has the flying height f in the range which is 10 -20-micron meter since it changes with temperature. Thus, at the time of rotation, permanent magnet 35 edge is carried out about 5 micron m, the bearing surface at least carries out 10 - 20-micron meter surfacing at shaft orientations, and a rotation posture is not affected.

[0046] Drawing 12 is drawing for explaining justification of the permanent magnet 35 in drawing 11 . In the cylinder 32 within a shaft 11, a permanent magnet 35 is held movable by adult holding power rather than the magnetic-attraction force by eye a running fit. A permanent magnet 35 is made to fully project beforehand on a shaft 11 at the time of assembly, a sleeve 12 is combined, and apply an adult push pressure between a sleeve 12 and a shaft 11 from the magnetic-attraction force, and the crowning of a sleeve 12 is made to contact, and a push pressure is removed where elastic deformation of the crowning of a sleeve 12 is carried out. After removing a push pressure, the crowning of a sleeve 12 returns to the original configuration, and the sleeve 12 which dotted-line 12b shows the sleeve in the condition of having applied the push pressure, and is shown as a continuous line shows the condition that the gap was established in the bearing surface of a shaft 11 and a

sleeve 12. The same effectiveness can be acquired even if it uses the elastic deformation of a flat spring instead of using the elastic deformation of the crowning of a sleeve 12.
[0047] The example which drawing 13 prepares a ring-like member in an end of the sleeve, and regulates the shaft-orientations location of moving part is shown, and drawing 13 (a) expands the sectional view in the right half of a motor, drawing 13 (b) expands the cross-section section 89 of the ring-like member circumference, and it is shown. In this example, the edge of a sleeve 12 shall have the through tube which joints projected part 86a with the ring-like member 24. The ring-like member 24 is beforehand inserted in the annular crevice 26 of the shaft 11 periphery section, is combined with a sleeve 12, it dashes the inner circumference section of the ring-like member 24 against the edge 87 of said annular crevice 26 with a jig 88 while it makes the through tube of said projected part 86a and the ring-like member 24 joint through the access hole 25, is mutually inserted in said projected part 86a, and is made to fix it to it, after the ring-like member 24 has carried out elastic deformation.
[0048] The shaft-orientations elastic deformation of the ring-like member 24 considers as about 20 micron m in said assembly process, and even when the reinforcement of the ring-like member 24 and said projected part 86a which suiting inserts in is fully applied to size, then an impact, the shaft-orientations movement magnitude of moving part including a hub 12 can be restricted to an about [20 micron m] slight amount. Although the demand given to wanting to restrict the shaft-orientations movement magnitude of a magnetic disk to a slight amount is strong, a demand can be filled with examples, such as HDD, by using the elastic deformation of the ring-like member 24 like this example, without setting up each part material tolerance severely. The ring-like member 24 and said projected part 86a can be assembled, can raise bonding strength with means, such as adhesion and welding, further behind, and can also raise shock resistance.
[0049] In the first and the second example, stainless steel, a copper alloy, and the ingredient used for the fluid and the gas hydrodynamic bearing from the former like the ceramics can be used as an ingredient of a shaft and a sleeve homaxial receiving part. It is effective in reducing the wear at the time of deactivation to form thin films, such as nickel, titanium, DLC, and second-class-ized molybdenum, in one front face of the bearing surface, and it is desirable.
[0050] Moreover, about the manufacture approach of a bearing part, as the shaft of a convex configuration of the bearing member in connection with this invention being natural as an example shows, mold omission is easy also for the sleeve which is a concave surface in the configuration extended upwards, and the inclination can carry out coincidence shaping of it also including a dynamic pressure slot using techniques, such as a press or injection molding. Therefore, die forming by the ceramics, a sintered alloy, etc., die forming using the resin ingredient which was excellent in abrasion resistance like PPS (polyphenylene sulfide resin) containing a carbon fiber, etc. are possible, and it is suitable for manufacture by low cost.
[0051]
[Effect of the Invention] As mentioned above, if it depends on the fluid and gas hydrodynamic bearing motor of this invention as explained using the example Bearing has a dynamic pressure slot in the semi-sphere configuration bearing surface. The temperature compensation of the load-carrying capacity of thin-shape-izing of stabilization of the rotation posture which is the simple structure of equilibrating the load-carrying capacity and the magnetic-attraction force by the pressure of the raised fluid or a gas, and is a technical problem, the formation of mass-production low cost by die forming, a fluid, and a gas hydrodynamic bearing motor, and rotation section support, and low current-ization ** -- it can realize simultaneously and the purpose of this invention can fully be attained. It can use for rotation mold storage, such as a small magnetic disk drive and an optical disk unit, the cooling fan of CPU, etc. especially.

[Translation done.]

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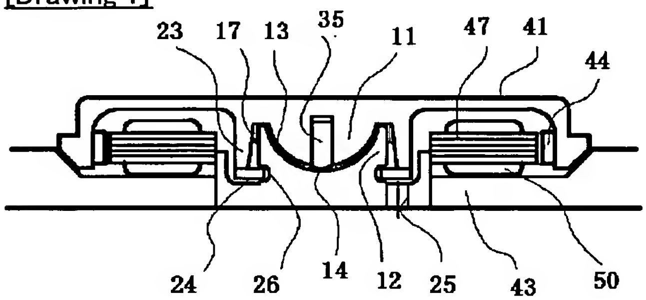
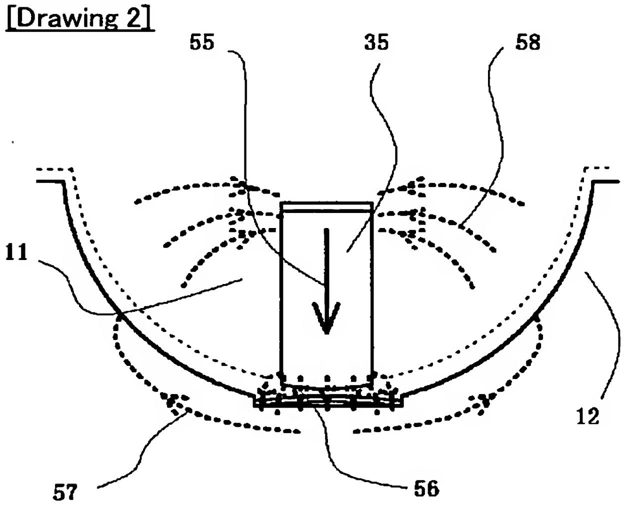
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

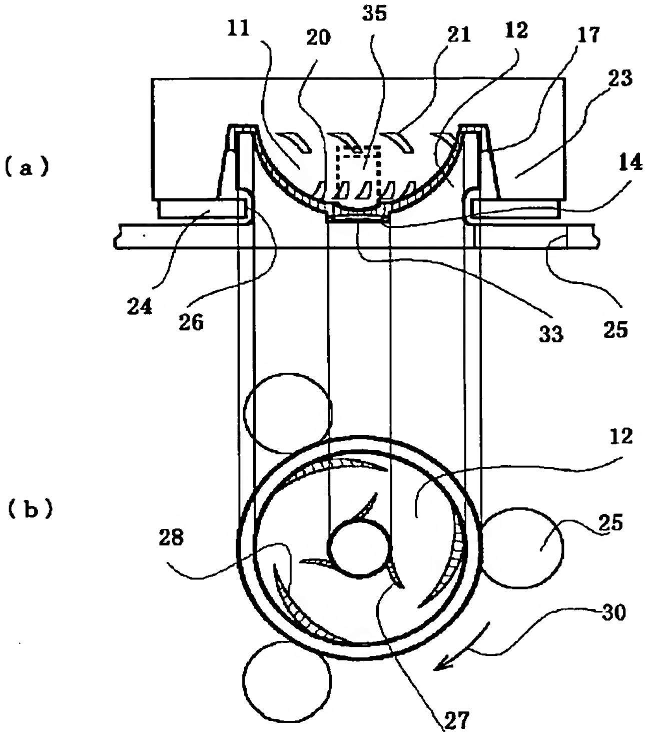
[Drawing 1]



[Drawing 2]



[Drawing 3]



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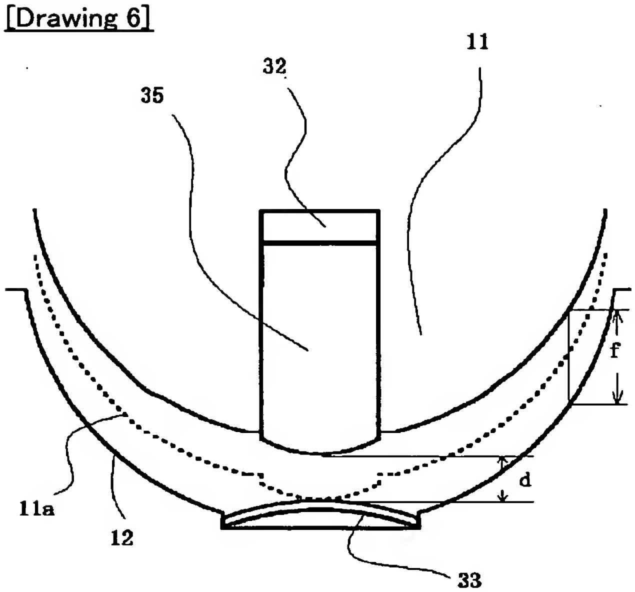

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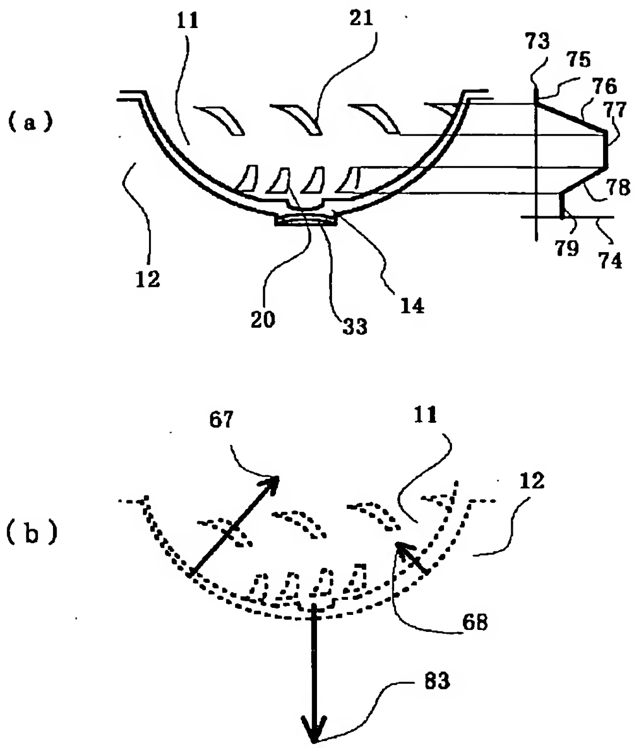
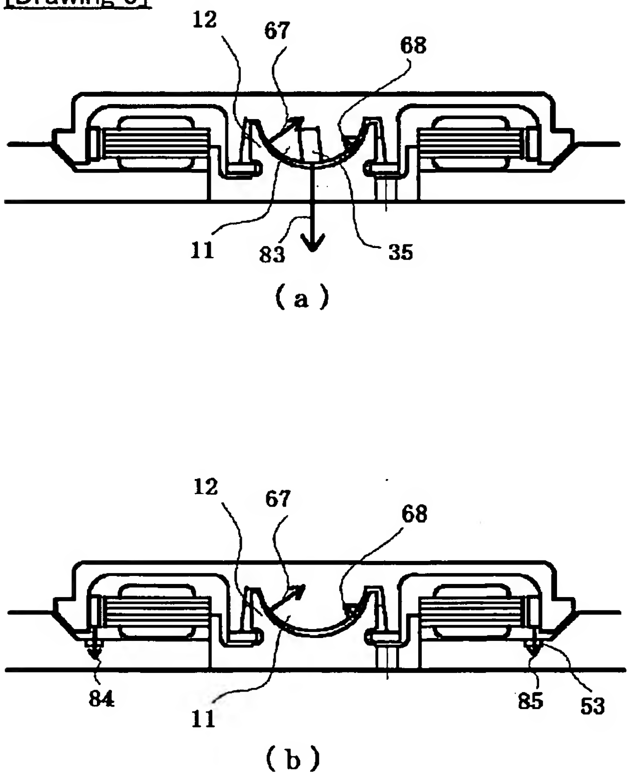
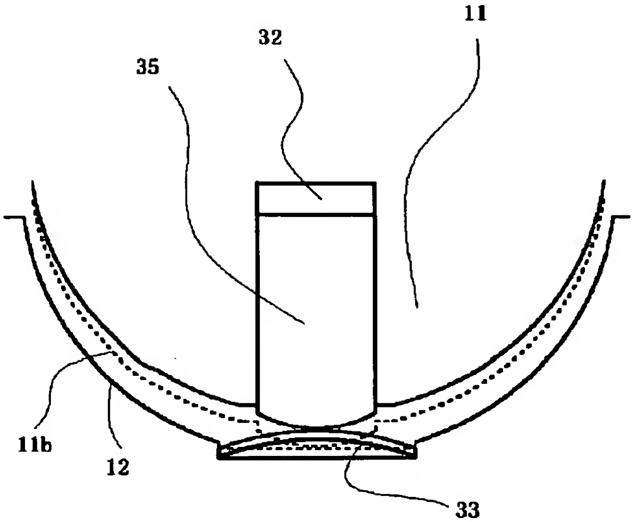


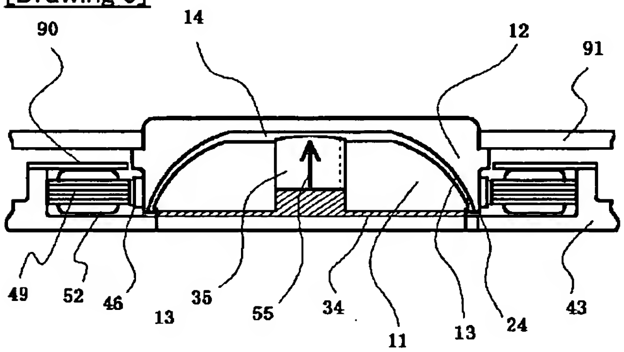
[Drawing 5]



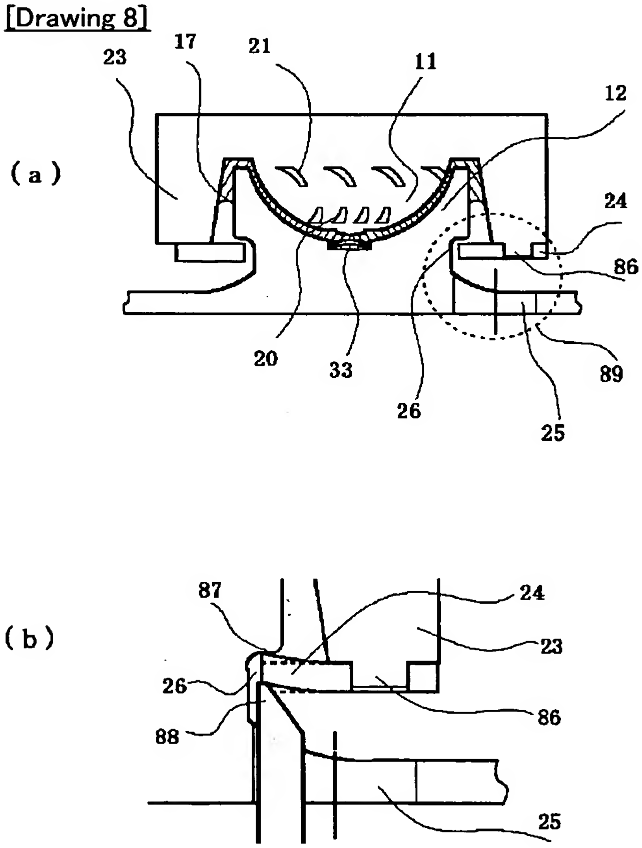
[Drawing 7]



[Drawing 9]

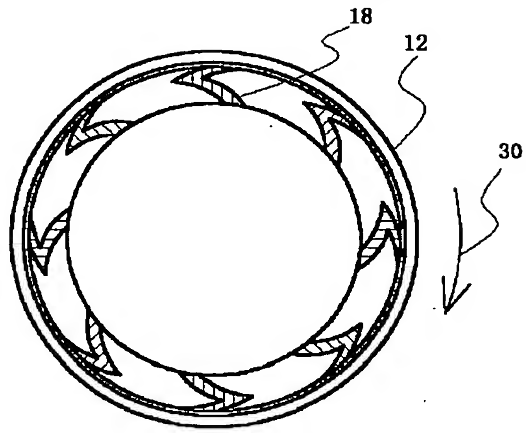


[Drawing 8]

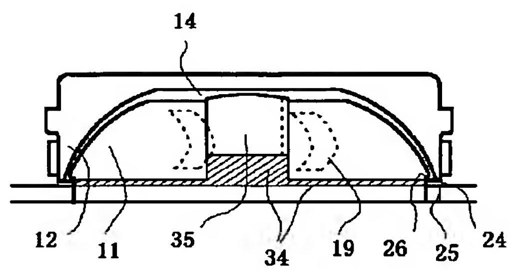


[Drawing 10]

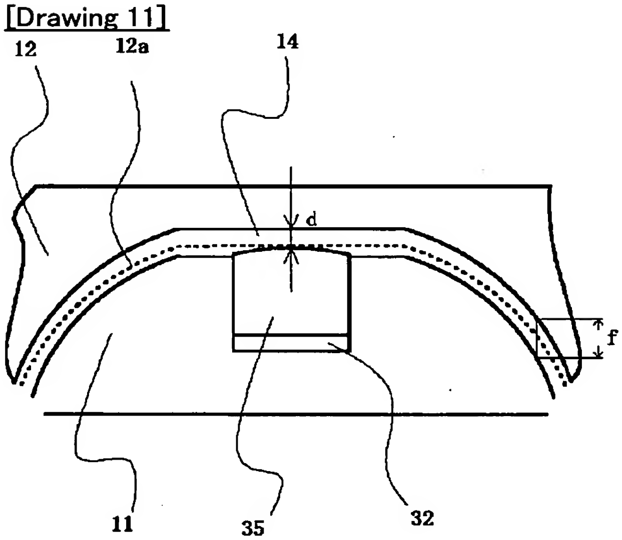
(a)



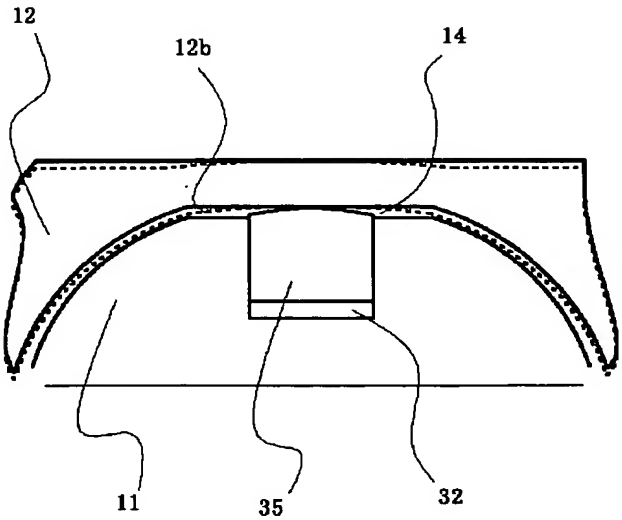
(b)



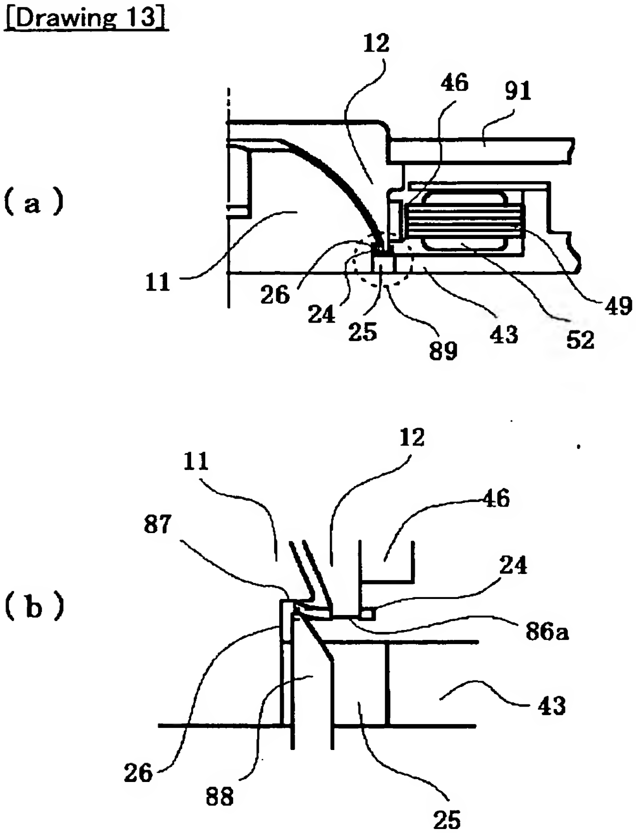
[Drawing 11]



[Drawing 12]



[Drawing 13]



[Translation done.]